

Principles of Development and Evaluation of Pictograms

João Neves^{1,2}, Fernando Moreira da Silva¹, Daniel Raposo^{1,2}, and José Silva¹

¹CIAUD, Research Centre for Architecture, Urbanism and Design, Lisbon School of Architecture, Universidade de Lisboa, Portugal

²Instituto Politécnico de Castelo Branco, Escola Superior de Artes Aplicadas, Portugal

ABSTRACT

This article is the result of an investigation in information design, which has communication design as its field and guidance and public information systems has theme, with a focus on tourist signage. The article focuses on the design process and how designers develop pictograms for guidance and information, but also on the evaluation of these pictograms, taking into account a specific user. The article aims to present principles for the development and evaluation of pictograms, aimed at a professional context and applicable in pedagogical environments. This is a study based on case studies, direct observation and literature review, aiming to define design principles for the development and evaluation of pictograms, principles that are expected to make guidance and public information systems more inclusive, accessible, ergonomic and user-centered.

Keywords: Design, Information design, Information systems, Pictograms systems

INTRODUCTION

Currently, the use of pictograms is frequent and diverse, in digital or printed media, whether in mobile devices, applications, technological means, panels, machines and mechanisms, instructions, information, signage, infographics and many other applications. This article focuses on the area of tourism, where pictograms play an important role in autonomy, mobility and ease of access to certain attractions, facilities and equipment, specifically in guidance and public information systems, with a focus on tourist signage.

The increase in tourist demand has led to an increase in the supply of new tourist attractions and facilities, to the growth in the supply of transport, triggering the need to improve the mobility of tourists traveling in unknown spaces, with guidance and public information systems being able to contribute to the autonomous mobility (Neves, 2012).

In this context, the use of pictograms as a simplified language accessible to a majority, can contribute to the clear decoding of messages, without ambiguities. From the multiplicity of information and guidance systems that use pictograms, it is important to evaluate their effectiveness in the context of tourism, their graphic and functional quality focused on the user's needs, as well

as implementing principles for the development and evaluation of pictograms in order to improve systems applied to tourism.

The article focuses on the design process and how designers develop pictograms for guidance and information, but also in the evaluation of these pictograms considering a specific user. It is intended to define design principles for the development and evaluation of pictograms, principles that are expected to make public guidance and information systems more inclusive, accessible, ergonomic and user-centred.

PICTOGRAMS AND TOURISM

The mobility associated with tourism brought the need to communicate clear and universal messages to multiple audiences of different origins, using a simplified language accessible to a majority. Pictographic systems can play this role as simplified and organized visual elements to communicate messages.

A pictogram is a simplified figurative sign that represents things and objects in the environment, through graphics such as a simplified drawing or an illustration. Pictograms graphically describe objects, activities or concepts through figurative, non-verbal drawings, that must be direct, easy to understand and decode.

But we designate as pictograms certain signs that in reality are not, since they refer to abstract notions, schemes of an idea, a concept or a non-visualizable phenomenon that determine concepts – the ideograms. Although pictograms appear to be absolutely self-explanatory and universal, they actually have cultural limitations and need to be learned. Thus, it is important to develop user-centered systems, recognizing their limitations in the decoding of visual codes, and for this it is necessary to implement principles of development and evaluation of pictograms that meet the real needs of the public.

Thus, it matters to develop user-centered systems, recognizing their limitations in the decoding of visual codes, being necessary to implement principles of development and evaluation of pictograms that meet the real needs of the public.

PRINCIPLES OF DEVELOPMENT

The ISO TR 7239 standard provides a set of procedures and establishes technical criteria that must be considered when developing or using graphic symbols. Although the document has been discontinued, it exposes a set of processes for the development or adoption of symbols, as well as visual design criteria and the process of implementing symbols for public information, which we believe are important for the development of pictograms. (ISO TR 7239, 1984, pp. 4–16).

The ISO 22727 standard also specifies the requirements for the creation and design of public information symbols, being organized into four essential parts: Procedure for creating a new public information symbol; Attribution of meaning, function and image content to the public information symbol;

Graphic symbol design principles; Layout of templates (ISO 22727, 2007, pp. 2–24).

The definition of principles, criteria and guidelines for the design of graphic symbols for use in safety signs are similarly presented in ISO 3864, part 3. This presents a set of considerations about the design and standardization of graphic symbols and establishes an interesting set of criteria for project development. Additional design guidelines for the development of the safety signs project are also presented, providing indications on the content of the graphic symbol image (ISO 3864-3, 2012, pp. 2–29).

The ISO 7001 standard specifies a system of graphic symbols for public information purposes, giving some indications about the symbols, also defining their meanings and categorization (ISO 7001, 2007, pp. 2–55). The ISO 7010 standard also establishes a pictographic system of safety signage and emergency. The referents and respective categorization of the pictograms are presented, as well as a list of safety signs (ISO 7010, 2019, pp. 2–297).

Rosa (2012) defines four systematized pictogram design methods, composed of regulatory principles (grid), generative principles (grid and structure) and formal elements (syntactic formal attributes that articulate with each other and with the structure). Standardized modular grid design method (characterized by the use of modules, which will fill the structure of the pictogram); In-line modular design method (definition of the modular element, which will be extended from point A to point B, filling the pictogram structure); Geometric design method (application of geometric elements to generate pictograms, regulating their thickness and graphic style, reducing the formal attributes of the pictogram to the essential minimum); Free design method (application of an original graphic style, conveyed through the tool used in its design, which defines the syntactic formal attribute).

Joan Costa (1989) defines a methodology for creating signage programs, consisting of seven steps: Contact; Collection of information; Organization; Graphic design; Accomplishment; Supervision; Experimental control. In the fourth stage, concerning graphic design, the methodology defines the following phases: Establishment of a module for composition (taking into account the distribution of textual, iconic and chromatic elements); Development of pictograms (semantic analysis (univocal meaning), syntactic (formal and stylistic unit) and pragmatic (visibility, resistance at a distance), selection of typography and chromatic definitions); Realization of prototypes; Selection of materials; Standards Manual; Production.

González-Miranda and Quindós (2015) present principles and method for the design of a pictogram system, which after the conceptual phase should start with the definition of referents, sketches, syntactic procedures (relationship between the various pictograms and the system), definition of constructive grid and graphic development.

EVALUATION OF PICTOGRAMS

In order to evaluate and validate pictographic systems, there are several tests that allow testing the signs with users, avoiding the development of solutions that are not suitable for the public. The ISO (International Organization for

Standardization) has developed over the years in this area a series of test methods aimed at evaluating graphic symbols.

The ISO 9186 standard is constituted by three parts. Part 1 specifies a method for testing comprehensibility of graphic symbols. The standard makes it possible to measure which variant of a graphic symbol communicates the intended message, presenting principles and preliminary steps to the comprehension test and the entire development process, as well as determining the most comprehensible variant and presenting, attached to the standard, test examples (ISO 9186-1, 2014, pp. 2–17).

Part 2 of the standard specifies a method for testing perceptual quality of graphic symbols, which aims to verify that the elements that make up a graphic symbol are easily identifiable by the sample of users. It presents the preliminary steps to the test, test procedures, analysis of results, presentation of results and, in the annex, clarification of terms and approach (informative) and approach and instructions to respondents (normative) (ISO 9186-2, 2008, pp. 2–12).

Finally, part 3 of ISO 9186 specifies a method for testing symbol referent association with graphic symbols, intended to communicate information to users who are familiar with what the symbol is intended to denote or represent (the referent). The intention is to develop graphic symbols that are correctly recognized by users familiar with the referents when no explanatory text is presented. The standard presents principles and preliminary steps to testing, testing symbol association with referent, analysis and presentation of results, and variant determination. (ISO 9186-3, 2014, pp. 2–13).

Also with regard to the development of pictographic systems, usability tests are often used to assess the graphic and functional quality of signs, with four types being highlighted: Exploration Test (assess the effectiveness of a preliminary symbol); Assessment Test (intended to assess the decoding of the message and the understanding of the meaning of symbols); Validation Test (estimates the behavior of symbols against pre-established standards); Comparison Test (aimed at qualitatively comparing the intrinsic characteristics of the different signs).

In order to test the effectiveness of the system developed in a real context, visibility tests “in situ” are also applied, which aim to evaluate the graphic and functional quality of the developed system, as well as its ability to communicate with the user in the space or territory to be validate, where models are applied as faithful as possible to the original to be applied, preferably under real physical conditions.

METHOD

The development of pictographic systems is often associated with corporate identity or branding, resulting in a language that is more aesthetic and less functional in its objective. The trends and graphic references dictated by the markets also influence the development of pictograms, so it would be important to evaluate the results of the application of principles of development and evaluation of pictograms, directed to a professional context and eventually tested in pedagogical environments.

From on this context, this article aimed to understand the design process and the way in which designers develop pictograms, focusing the study on the analysis of development methods and principles, but also on the evaluation and validation of pictograms. An exploratory research was carried out, with a qualitative basis, having been developed a literature review in the area of information systems, guidance, signage, pictography and graphic standardization.

RESULTS AND DISCUSSION

A significant set of principles and methods for developing pictorial systems were identified in the present investigation, as well as methods for evaluating and validating these same pictograms.

The ISO TR 7239 standard (1984, pp. 4–16), indicates procedures for the development or adoption of symbols for public information, starting the process with the determination of the need for a new symbol, followed by design tests and collection of symbols in use, to which design tests must be applied (adequacy test and comprehension test), followed by the normalization of the verbal descriptions of the image content, graphic development, carrying out a correspondence test (relationship of the developed symbol with the system), graphic normalization of the symbol, definition of function and field of application. Technical recommendations for the development and implementation of the symbols are also presented.

Likewise, ISO 22727 (2007, pp. 2–24) defines procedures for creating a new symbol, mentioning that the design of a graphic symbol must be understandable, be associated with the intended meaning and easily distinguishable from other graphic symbols, contain only those details that contribute to its understanding, be based on objects, activities, etc., or a combination of these, and retain its characteristics when reduced. The standard also specifies indications for the design of symbols. Attached, the standard presents additional guidelines and a set of recommendations for designers when creating and designing a graphic symbol. The ISO 7001 and 7010 standards present a diverse set of symbols for public information and symbols for safety signs respectively. The ISO 7001 standard provides general guidelines regarding the development of symbols.

Concerning the graphic design of signage programs Joan Costa (1989), states that the process must start with the establishment of a composition module, development of sketches, development of pictograms (based on semantic, syntactic and pragmatic analysis), selection of typography and chromatic definitions, prototyping, material selection and standards manual. González-Miranda and Quindós (2015), define a process for the design of a pictogram system that begins with a conceptual phase, definition of referents, sketches, syntactic procedures (relationship between the various pictograms and the system), definition of a constructive grid and graphic development of the system. Still regarding the design of the pictograms, Rosa (2012) defines four design methods: grid patterned modular, line modular, geometric and free.

The ISO 9186 standard presents three test methods for judged comprehensibility and for comprehension of graphic symbols. Part 1 of the standard specifies a method for testing the comprehensibility of graphic symbols; Part 2 of the standard describes the method for testing perceptual quality of graphic symbols; Part 3 of the standard describes the method for testing symbol referent association with graphic symbols.

It is also important to highlight the role of usability tests in the context of the evaluation and validation of pictograms, where four main typologies were identified: exploration tests, evaluation tests, validation tests and comparison tests. In order to test the effectiveness of the system developed in a real context, the “in situ” visibility tests are also highlighted.

From the results presented, it is possible to extrapolate a set of methodological principles and technical indications aimed at designers and the academic environment, allowing the development of more inclusive, accessible, ergonomic and user-centered pictographic systems. It is also important to highlight the process of evaluating the pictograms. For various reasons, pictographic systems are not always validated, which has profound implications for their graphic and functional quality and for the decoding and interpretation of codes. The present work presented a set of evaluation tests that can contribute to the improvement of guidance and public information systems.

CONCLUSION

The research developed allowed the definition of design principles for the development and evaluation of pictograms, which are expected to contribute to more functional, inclusive public information and guidance systems, accessible to a majority of users and that facilitate the performance of tasks inherent to the process of visual and cognitive interaction with the systems.

The increase in tourist demand has led to an increase in the mobility of tourists in unknown places, contributing pictographic systems to autonomous mobility, where the use of pictograms (as a simplified and accessible language for a majority) can contribute to the clear decoding of messages, without ambiguities.

The results presented allow us to define a set of methodological principles and technical indications that form an important toolkit for design companies, aimed at designers, but also important for design teaching, providing a relevant pedagogical tool for project-based learning.

Due to the nature of this article, there were limitations in the synthesis of the contents resulting from the literature review and the application of the method, which will certainly be applied in future works. It is recommended for future investigations, an extension of the exploratory investigation to methods and techniques of graphic development of pictograms, as well as methods of evaluation of pictograms.

REFERENCES

- Costa, J. (1989) Señalética. Barcelona: Ceac,
Dowse, R. & Mansoor, L.E. (2004) Design and Evaluation of a New Pharmaceutical Pictograms Sequence to Convey Medicine Usage. *Ergonomics SA*, 2, 29–41.

- González-Miranda, E. & Quindós, T. (2015) *Diseño de iconos y pictogramas*. Valencia: Editorial Campgràfic.
- International Organization for Standardization [ISO] (1984). ISO / TR 7239 *Development and principles for application of public information symbols*. Geneva: ISO.
- International Organization for Standardization [ISO] (2007). ISO 22727 *Graphical symbols: Creation and design of public information symbols – Requirements*. Geneva: ISO.
- International Organization for Standardization [ISO] (2007). ISO 7001 *Graphical symbols: Public information symbols*. Geneva: ISO.
- International Organization for Standardization [ISO] (2007). ISO 9186-1 *Graphical symbols - Test methods: Part 1 - Methods for testing comprehensibility*. Geneva: ISO.
- International Organization for Standardization [ISO] (2008). ISO 9186-2 *Graphical symbols - Test methods: Part 2: Method for testing perceptual quality*. Geneva: ISO.
- International Organization for Standardization [ISO] (2012). ISO 3864-3 *Graphical symbols: Safety colours and safety signs - Part 3: Design principles for graphical symbols for use in safety signs*. Geneva: ISO
- International Organization for Standardization [ISO] (2014). ISO 9186-3 *Graphical symbols - Test methods: Part 3: Method for testing symbol referent association*. Geneva: ISO.
- International Organization for Standardization [ISO] (2019). ISO 7010 *Graphical symbols - Safety colours and safety signs - Registered safety signs*. Geneva: ISO.
- Neves, J. (2012) *Sistema de signos para informação turística: Metodologia para o desenvolvimento de sistemas sinaléticos*. Unpublished PhD thesis, Faculdade de Arquitetura, Universidade Técnica de Lisboa.
- Rosa, C. (2012) *Sistemas de Informação Pictográfica. O universo dos pictogramas: métodos e procedimentos de design para a obtenção de coerência formal*. Unpublished PhD thesis, Faculdade de Arquitetura, Universidade Técnica de Lisboa.